

PIERO GEMDENELLI
MILANO

VOL.107 NO.GT8. AUG. 1981

**JOURNAL
OF THE
GEOTECHNICAL
ENGINEERING
DIVISION**

PROCEEDINGS OF
THE AMERICAN SOCIETY
OF CIVIL ENGINEERS



AMERICAN SOCIETY OF CIVIL ENGINEERS

BOARD OF DIRECTION

President
Irvan F. Mendenhall

Past President
Joseph S. Ward

President Elect
James R. Sims

Vice Presidents
Robert D. Bay
Francis J. Connell

Directors

Martin G. Abegg	Paul R. Munger
Floyd A. Bishop	William R. Neuman
L. Gary Byrd	Leonard S. Oberman
Larry J. Feeser	John D. Parkhurst
John A. Focht, Jr.	Celestino R. Pennoni
Sergio Gonzalez-Karg	Robert B. Rhode
James E. Humphrey, Jr.	S. Russell Stearns
Richard W. Karn	William H. Taylor
Leon D. Luck	Stafford E. Thornton
Arthur R. McDaniel	Robert E. Whiteside
Richard S. Woodruff	

EXECUTIVE OFFICERS

Eugene Zwoyer, *Executive Director*
Julie E. Gibouleau, *Assistant to the Executive Director*
Louis L. Meier, *Washington Counsel/Assistant Secretary*
William H. Wisely, *Executive Director Emeritus*
Michael N. Salgo, *Treasurer*
Elmer B. Isaak, *Assistant Treasurer*

STAFF DIRECTORS

Donald A. Buzzell, *Managing Director for Education and Professional Affairs*
Robert A. Crist, Jr., *Managing Director for Publications and Technical Affairs*
Alexandra Bellow, *Director, Human Resources*
David Dresia, *Director, Publications Production and Marketing*
Barker D. Herr, *Director, Membership*
Richard A. Jeffers, *Controller*
Carl E. Nelson, *Director, Field Services*
Don P. Reynolds, *Director, Policy, Planning and Public Affairs*
Bruce Rickerson, *Director, Legislative Services*
Albert W. Turchick, *Director, Technical Services*
George K. Wadlin, *Director, Education Services*
R. Lawrence Whipple, *Director, Engineering Management Services*

COMMITTEE ON PUBLICATIONS

Stafford E. Thornton, *Chairman*
Martin G. Abegg
John A. Focht, Jr.
Richard W. Karn
Paul R. Munger
William R. Neuman

GEOTECHNICAL ENGINEERING DIVISION

Executive Committee
Robert Schuster, *Chairman*
Ernest T. Selig, *Vice Chairman*
William F. Swiger
Harvey E. Wahls
Robert T. Darragh, Jr., *Secretary*
Roy E. Olson, *Management Group E Contact Member*

Publications Committee

William F. Marcuson III, *Chairman and Editor*
O. B. Andersland
Fred H. Kulhawy
Warren J. Baker
C. C. Ladd
Don C. Banks
Poul V. Lade
James M. Bell
Leonard J. Langfelder
Chandra S. Brahama
Felipe A. Len-Rios
John T. Christian
Gholamreza Mesri
G. W. Clough
Donald J. Murphy
Tuncer B. Edil
S. V. Nathan
Herbert H. Einstein
Thom L. Neff
Arley G. Franklin
Edward A. Nowatzki
D. H. Gray
Michael W. O'Neill
Bobby Hardin
Jean H. Prevost
Cornelius J. Higgins
Adel Saada
William H. Hightler
Surendra K. Saxena
Robert D. Holtz
Robert L. Schiffman
Izzat M. Idriss
Woodland G. Schockley
L. H. Irwin
Marshall L. Silver
Jey K. Jeyapalan
Glen S. Tarbox
Reuben H. Karol
G. R. Thiers
H. Y. Ko
D. D. Treadwell
William D. Kovacs
Charles R. Ullrich
Leland M. Kraft
J. Lawrence Von Thun
Raymond J. Krizek
R. N. Yong
E. T. Selig, *Exec. Comm. Contact Member*

PUBLICATION SERVICES DEPARTMENT

David Dresia, *Director, Publications Production and Marketing*

Technical and Professional Publications

Richard R. Torrens, *Manager*
Chuck Wahrhaftig, *Chief Copy Editor*
Corinne Bernstein, *Copy Editor*
Linda Ellington, *Copy Editor*
Shiela Menaker, *Production Co-ordinator*
Richard C. Scheblein, *Draftsman*

Information Services

Elan Garonzik, *Editor*

PERMISSION TO PHOTOCOPY JOURNAL PAPERS

Permission to photocopy for personal or internal reference beyond the limits in Sections 107 and 108 of the U.S. Copyright Law is granted by the American Society of Civil Engineers for libraries and other users registered with the Copyright Clearance Center, 21 Congress Street, Salem, Mass. 01970, provided the appropriate fee is paid to the CCC for all articles bearing the CCC code. Requests for special permission or bulk copying should be addressed to the Manager of Technical and Professional Publications, American Society of Civil Engineers.

CONTENTS

Pressuremeter Tests at Very Shallow Depth <i>by Jean-Louis Briaud and Donald H. Shields</i>	1023
Current USA Practice: Slurry Wall Specifications <i>by Richard A. Millet and Jean-Yves Perez</i>	1041
Dynamic FEM Model of Oroville Dam <i>by John Vrymoed</i>	1057
Undrained Settlement of Plastic and Organic Clays <i>by Roger Foott and Charles C. Ladd</i>	1079
Piles Subjected to Torsion <i>by M. F. Randolph</i>	1095
Experimental Study of Footings in Layered Soil <i>by Adel M. Hanna</i>	1113
Permanent Displacements Due to Cyclic Wave Loading <i>by W. Allen Marr, Jr., and John T. Christian</i>	1129

The Journal of the Geotechnical Engineering Division (ISSN 0093-6405) is published monthly by the American Society of Civil Engineers. Publications office is at 345 East 47th Street, New York, N.Y. 10017. Address all ASCE correspondence to the Editorial and General Offices at 345 East 47th Street, New York, N.Y. 10017. Allow six weeks for change of address to become effective. Subscription price to members is \$16.00. Nonmember subscriptions available; prices obtainable on request. Second-class postage paid at New York, N.Y. and at additional mailing offices. GT.

POSTMASTER: Send address changes to American Society of Civil Engineers, 345 East 47th Street, New York, NY 10017.

The Society is not responsible for any statement made or opinion expressed in its publications.

DISCUSSION

Proc. Paper 16408

Laboratory Tests on Model Piled Raft Foundations,* by Terence J. Wiesner and Peter T. Brown (July, 1980).

by Joe O. Akinmusuru	1153
by Eldon Burley, Roger C. Harvey, Bhas kar Nath, and Lawrence A. Wood	1155
closure	1157

INFORMATION RETRIEVAL

The key words, abstract, and reference "cards" for each article in this Journal represent part of the ASCE participation in the EJC information retrieval plan. The retrieval data are placed herein so that each can be cut out, placed on a 3 × 5 card and given an accession number for the user's file. The accession number is then entered on key word cards so that the user can subsequently match key words to choose the articles he wishes. Details of this program were given in an August, 1962 article in CIVIL ENGINEERING, reprints of which are available on request to ASCE headquarters.

*Discussion period closed for this paper. Any other discussion received during this discussion period will be published in subsequent Journals.

16416 PRESSUREMETER TESTS AT VERY SHALLOW DEPTH

KEY WORDS: Clays; Critical depth; Depth factor (soils); Field tests; Modulus of deformation; Pavement design; Pavements; Pressure measurement; Sands; Soil mechanics

ABSTRACT: The pressuremeter shows considerable promise as a tool used in the design of pavements. The results of pressuremeter tests carried out at shallow depth can be influenced by the proximity of the ground surface. The influence is readily apparent in the case of limit pressure values, but little is known about the effect of depth on the pressuremeter modulus. However, the modulus is important for pavement design. A series of tests were run to resolve this dilemma. The pressuremeter modulus is hardly affected by the depth at which the test is run.

REFERENCE: Briaud, Jean-Louis (Asst. Prof., Civ. Engrg. Dept., Texas A & M Univ., College Station, Tex. 77843), and Shields, Donald H., "Pressuremeter Tests at Very Shallow Depth," *Journal of the Geotechnical Engineering Division, ASCE*, Vol. 107, No. GT8, Proc. Paper 16416, August, 1981, pp. 1023-1040

16458 SLURRY WALL SPECIFICATIONS

KEY WORDS: Design criteria; Objectives; Permeability; Quality control; Slurry excavation; Slurry trenches; Specifications; Subsurface structures

ABSTRACT: The critical design criteria and the resulting specifications for slurry trench diaphragm walls and cutoff walls are discussed. To establish diaphragm and cutoff slurry wall design criteria and specifications, the designer must clearly establish the objectives or end results that are to be obtained, and shape his specifications accordingly. There are many portions or applications of slurry wall work where truly an end-result specification may be appropriate. However, the application of end-result specifications in the present practice is a long way off until the owners and engineers gain a more thorough understanding and knowledge of the technical and construction procedures involved in slurry trench work.

REFERENCE: Millet, Richard A. (Principal, Woodward-Clyde Consultants, 3 Embarcadero Center, San Francisco, Calif. 94111), and Perez, Jean-Yves, "Current USA Practices: Slurry Wall Specifications," *Journal of the Geotechnical Engineering Division, ASCE*, Vol. 107, No. GT8, Proc. Paper 16458, August, 1981, pp. 1041-1056

16464 DYNAMIC FEM MODEL OF OROVILLE DAM

KEY WORDS: Acceleration; Bedrock; California; Dams (earth); Dynamic models; Earth dam performance; Earth dams; Earthquakes; Finite elements; Seismic stability; Shear modulus; Time factors

ABSTRACT: A dynamic finite element model was made of Oroville Dam. Oroville Dam is a 229 m high earth dam located in the foothills on the western slope of the Sierra Nevada in California. During August and September of 1975 the immediate area near the dam experienced seismic activity, with the main shock having a magnitude 5.7. Acceleration time histories were recorded on the crest and toe of the dam. The bedrock accelerations recorded near the dam were input into the finite element model, and the computed crest accelerations compared to the observed crest accelerations. A favorable comparison gives validity to the finite element model chosen.

REFERENCE: Vrymoed, John (Assoc. Engr., Div. of Safety Dams, Dept. of Water Resources, California), "Dynamic FEM Model of Oroville Dam," *Journal of the Geotechnical Engineering Division, ASCE*, Vol. 107, No. GT8, Proc. Paper 16464, August, 1981, pp. 1057-1077